

Pliocene and Quaternary seismic stacking pattern and distribution of contourites in the Algarve margin (Northern Gulf of Cadiz, Spain)

Estefanía Llave¹, Hugo Matias², F^o Javier Hernández-Molina³, Gemma Ercilla⁴, Dorrik A.V. Stow⁵ and Teresa Medialdea¹

- 1 Instituto Geológico y Minero de España (IGME), c/ Ríos Rosas, 23, 28003 Madrid, Spain. e.llave@igme.es , t.medialdea@igme.es
- 2 REPSOL, Exploration Spain. Paseo de la Castellana, 280, 4th floor. 28046 Madrid, Spain. hmatias@repsol.com
- 3 Facultad de Ciencias del Mar, Universidad de Vigo, 36200 Vigo, Spain. fjhernan@uvigo.es
- 4 Dpto. de Geología Marina y Oceanografía Física, Instituto de Ciencias del Mar, CMIMA-CSIC, Paseo Marítimo de la Barceloneta, E-08003 Barcelona, Spain. gemma@icm.csic.es
- 5 IPE-ECOSSE, Heriot Watt University, Edinburgh EH14 4AS, United Kingdom. dorrik.Stow@pet.hw.ac.uk.

Abstract: Three main changes in the sedimentary growth pattern within Pliocene and Quaternary contourite drifts in the Algarve margin are interpreted based on multichannel seismic profiles. Spatial distribution of major depocenters is mainly controlled by Pliocene tectonic structures, whose evolution controlled MOW behaviour. Nevertheless, after the Mid Pleistocene (MPR), the small-scale sedimentary stacking of the contourite drifts was more influenced by both climatic and sea-level changes.

Key words: Contourites, Algarve margin, Gulf of Cadiz, MOW, Pliocene and Quaternary.

INTRODUCTION

After the end of the Miocene, with the reopening of the Gibraltar Strait a large Contourite Depositional System (CDS) developed on the middle slope of the Gulf of Cadiz related to the permanent warm and saline intermediate Mediterranean Outflow Water (MOW) (Fig. 1). This CDS comprises both depositional and erosive features with distributed along the margin in five morphosedimentary sectors (Llave *et al.*, 2007).

In the Pliocene and Quaternary Gulf of Cadiz sedimentary record, four main depositional sequences were previously identified, and associated with important MOW palaeoceanographic changes. These sequences are bounded by four discontinuities with regional expression: M (Messinian), LPR (Lower Pliocene), UPR (Upper Pliocene) and MPR (Mid Pleistocene) (Llave *et al.*, 2001, 2007). The aim of this work is to present preliminary results on the Pliocene and Quaternary seismic stacking patterns and distribution of contourite drifts within the Algarve margin (Fig. 1). Our study focuses on the interpretation of profiles from a broad seismic database acquired by TGS-NOPEC in 2001-2002 and a compilation of older profiles from REPSOL. Borehole data from oil industry wells was used to calibrate seismic interpretation and seismic horizons.

RESULTS

Four main seismic units (from oldest to youngest: P1, P2, QI and QII) have been identified within the Pliocene-Quaternary sedimentary record of contourite drifts on the Algarve margin (Fig. 2). The boundaries of these units are marked by high amplitude reflections, which represent major discontinuities (M, LPR, BDQ and MPR in upward chronological order (Fig. 2). The BQD discontinuity was previously considered as an intra-upper Pliocene discontinuity (UPR, Llave *et al.*, 2001, 2007). However, the base of the

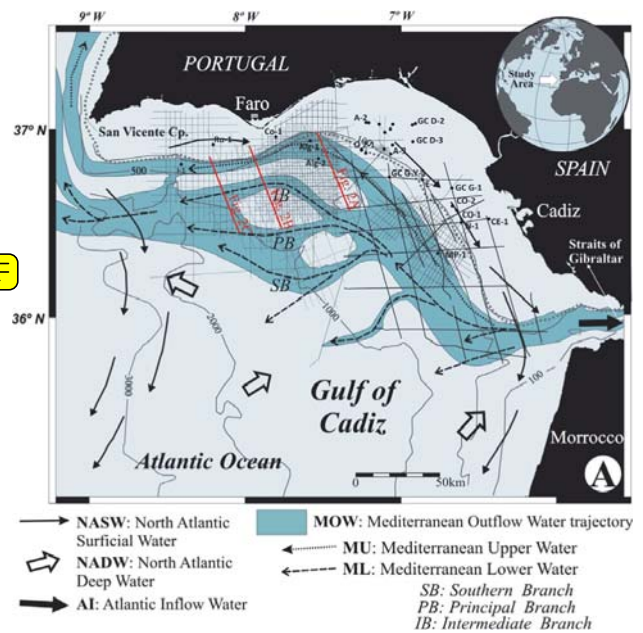


FIGURE 1. Location map showing main water-mass circulation along the margin and the seismic and borehole data.

Quaternary has recently been re-assigned by the International Commission on Stratigraphy (ICS) to ~2.6 Ma (Mascarelli, 2009) and we have therefore relabeled the reflector as BQD (Base Quaternary Discontinuity).

Seismic unit P1 is characterised by weak seismic reflections with upslope onlapping terminations. *Seismic unit P2* shows well stratified reflections with good lateral continuity an upslope prograding pattern, mounded in the north, representing the initiation of the elongated and separated drift. Parallel to subparallel reflections are observed across the rest of the *P2*, representing sheeted drifts affected by local deformation and exhibiting gentle anticline/syncline structures

and common faulting. *Seismic unit QI* shows a more pronounced mounded upslope-prograding stacking pattern forming an elongated and separated drift. The stacking pattern southward evolves to aggradational, representing a large sheeted drift, where the above mentioned local deformations are still observed. *Seismic unit QII* has a sigmoidal to oblique configuration prograding upslope (northward) as a mounded drift while parallel-laminated reflections with an aggrading pattern southward represent a sheeted drift. The deposits of this unit exhibit less deformation.

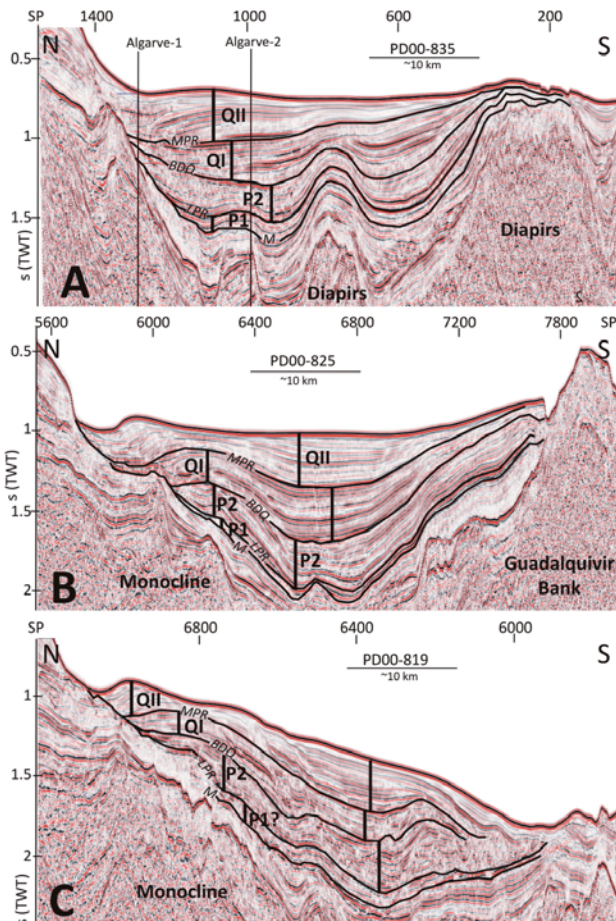


FIGURE 2. Multichannel seismic reflection profiles. A) Eastern zone; B) Central zone; C) Western zone. (data courtesy of TGS-NOPEC Geophysical Company ASA, for this contribution). See location in Figure 1.

The spatial distributions and thicknesses of the units allow identification of three zones with different structural controls: the eastern, central and western zones (Fig. 2A-C). The eastern zone is characterised by two NE-SW diapiric structures that have controlled the development of two internal sedimentary basins (Fig. 2A). During the Pliocene these structures were responsible for the development of a NE

trending contourite depocenter with thicknesses of ~400 ms. These structures play a minor role in sediment distribution during the Quaternary when E-trending depocenters ~600 ms thick developed. The central zone experiences direct control by the ENE-WSW Guadalquivir Bank in the south, and an E-W monocline structure in the north (Fig. 2B). These features resulted in a NE-trending depocenter of ~500 ms thick during the Pliocene. Nevertheless, during the Quaternary, a new E-trending major depocenter is observed, reaching ~800 ms maximum thickness. The western zone is still affected to the north by the monocline causing increased accumulation, with a NNE trend, in the southern part of the basin during the Pliocene and Quaternary (Fig. 2C). In general an upslope progradation of contourite drifts is observed, with the main depocenter migration towards the N and NW, during the Pliocene and Quaternary, especially after the Mid Pleistocene.

CONCLUSIONS

Three main changes are identified in the evolution of growth patterns of contourite drifts on the Algarve margin, during the Pliocene and Quaternary. Spatial distribution of major seismic unit depocenters are mainly controlled by the Pliocene tectonic structures with their evolution, locally affecting the MOW behaviour. However, after the Mid Pleistocene (MPR), the more detailed sedimentary stacking patterns have been more influenced by both climatic and sea-level changes than by structural controls.

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